US009324987B2

(12) **United States Patent**
Guen

(10) **Patent No.: US 9,324,987 B2**
(45) **Date of Patent: Apr. 26, 2016**

(54) **SECONDARY BATTERY**

(75) Inventor: **Minhyung Guen**, Yongin-si (KR)

(73) Assignees: **Samsung SDI Co., Ltd.**, Yongin-si (KR); **Robert Bosch GmbH**, Stuttgart (DE)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 512 days.

(21) Appl. No.: **13/048,663**

(22) Filed: **Mar. 15, 2011**

(65) **Prior Publication Data**

US 2012/0156531 A1 Jun. 21, 2012

(30) **Foreign Application Priority Data**

Dec. 20, 2010 (KR) 10-2010-0130956

(51) **Int. Cl.**

H01M 2/00	(2006.01)
H01M 4/64	(2006.01)
H01M 2/30	(2006.01)
H01M 2/04	(2006.01)
H01M 2/12	(2006.01)
H01M 2/22	(2006.01)
H01M 2/26	(2006.01)

(Continued)

(52) **U.S. Cl.**

CPC ***H01M 2/30*** (2013.01); ***H01M 2/043*** (2013.01); ***H01M 2/0426*** (2013.01); ***H01M 2/0473*** (2013.01); ***H01M 2/0486*** (2013.01); ***H01M 2/12*** (2013.01); ***H01M 2/22*** (2013.01); ***H01M 2/263*** (2013.01); ***H01M 2/365*** (2013.01); *H01M 2/0217* (2013.01); *H01M 2/0285* (2013.01); *H01M 2/266* (2013.01)

(58) **Field of Classification Search**

CPC H01M 2/00
USPC 429/53
See application file for complete search history.

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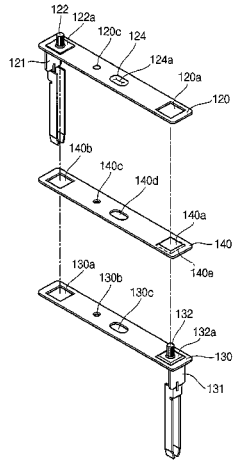
Primary Examiner — Jacob Marks

(74) *Attorney, Agent, or Firm* — Lewis Roca Rothgerber Christie LLP

(57) **ABSTRACT**

A secondary battery includes an electrode assembly including a first electrode plate, a separator, and a second electrode plate; a first collecting plate electrically coupled to the first electrode plate; a second collecting plate electrically coupled to the second electrode plate; a case containing the electrode assembly, the first collecting plate, and the second collecting plate; a first electrode terminal electrically coupled to the first collecting plate; a second electrode terminal electrically coupled to the second collecting plate; a first plate coupled to the first collecting plate and the first electrode plate and configured to seal the case; a second plate coupled to the second collecting plate and the second electrode terminal; and an insulation plate between the first plate and the second plate.

16 Claims, 5 Drawing Sheets



(51) **Int. Cl.**
H01M 2/36 (2006.01)
H01M 2/02 (2006.01)

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FIG. 1

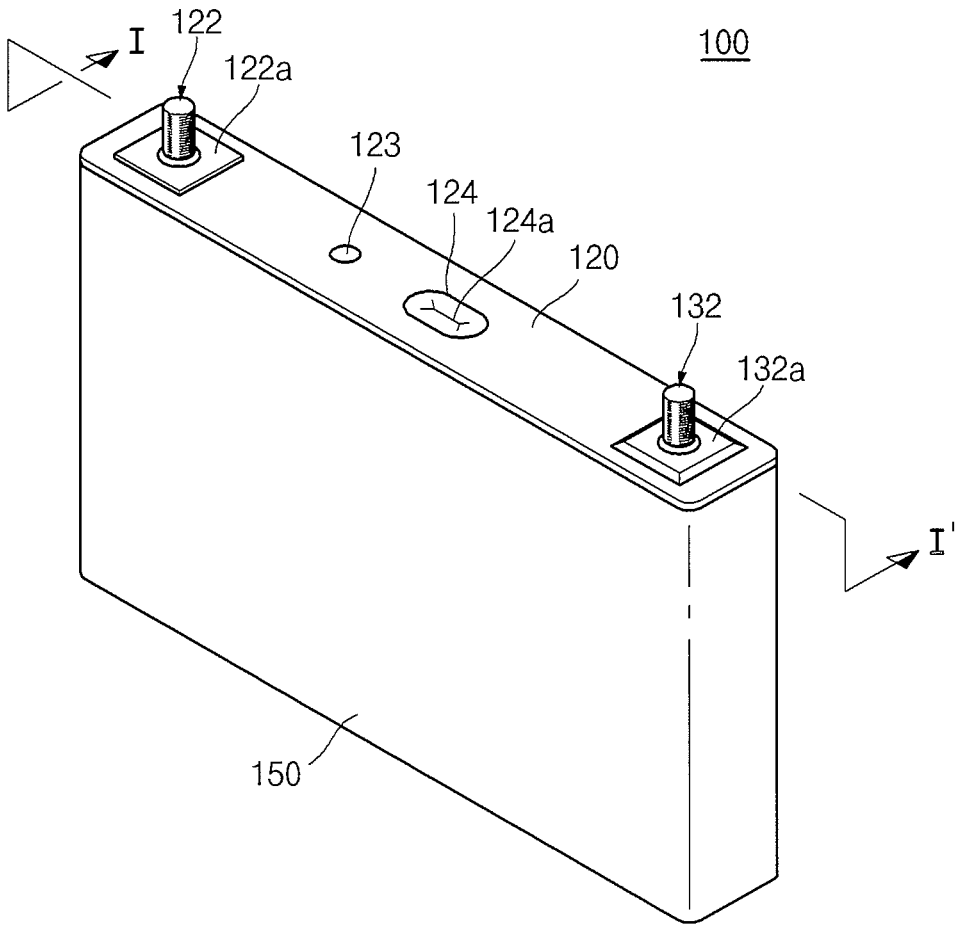


FIG. 2

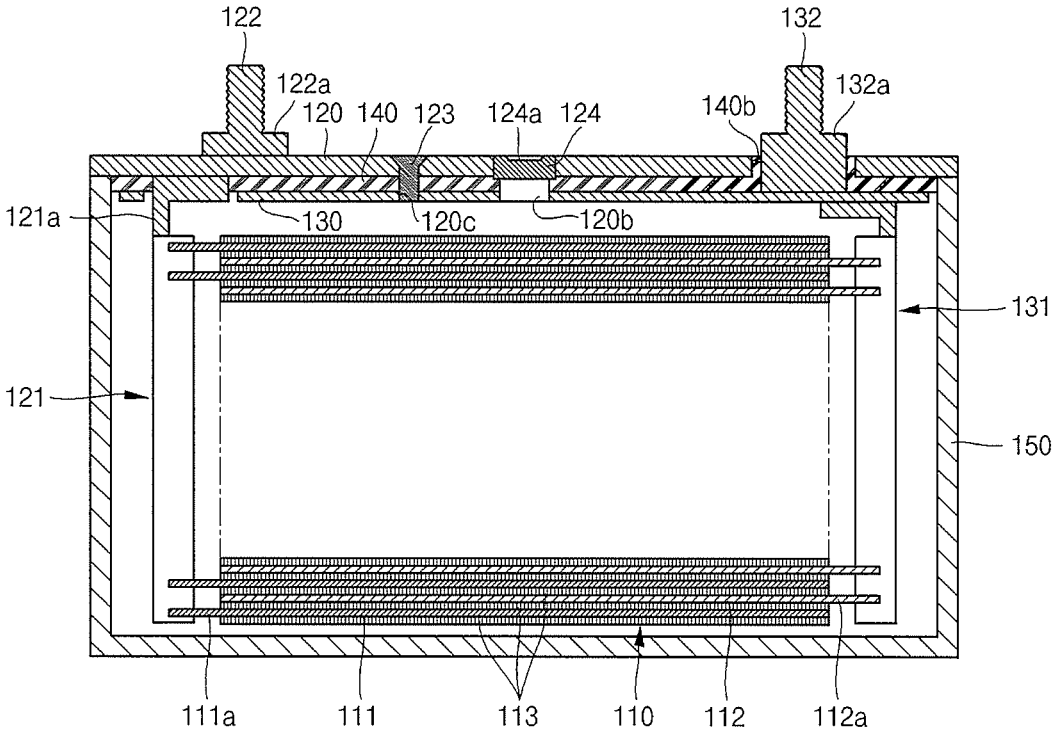
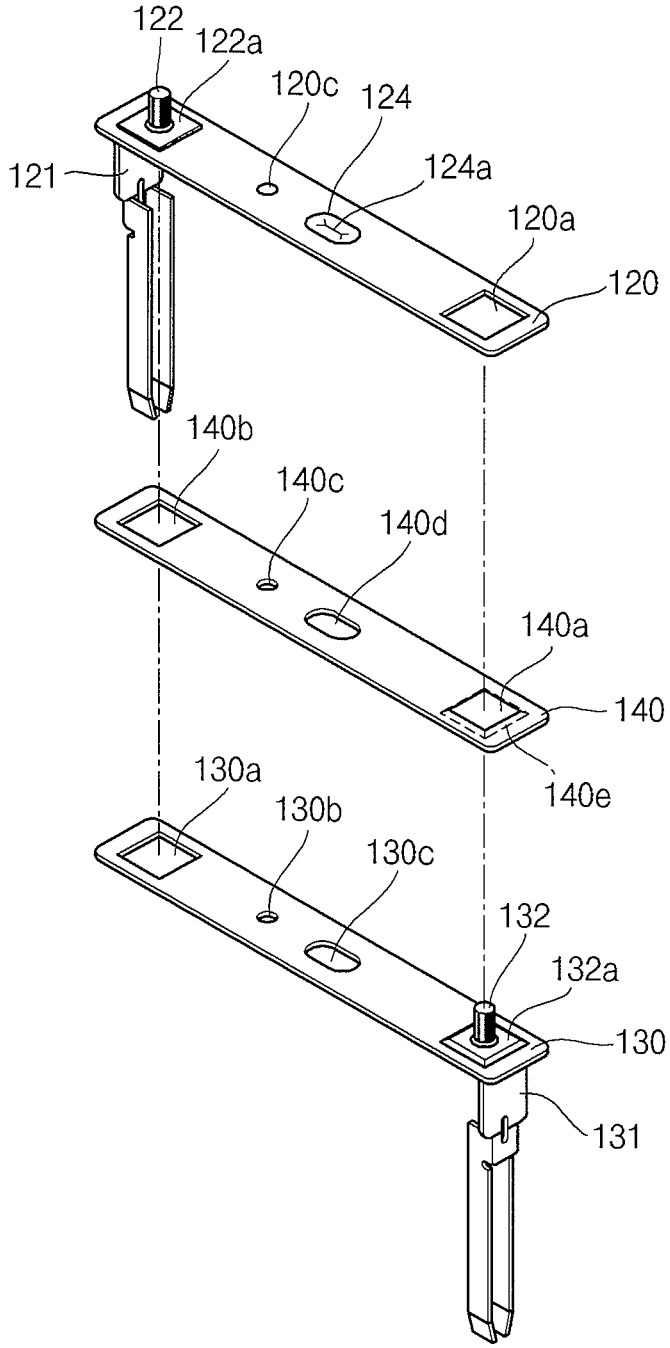

122
132
122a
120
140
123
124a
124
140b
132a
121a
130
120c
120b
131
121
150
111a
111
113
110
112
112a

FIG. 3


122
122a
120c
124
121
124a
120a
120
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140c
140d
140a
140
140e
130a
130b
130c
132
132a
130
131

FIG. 4A

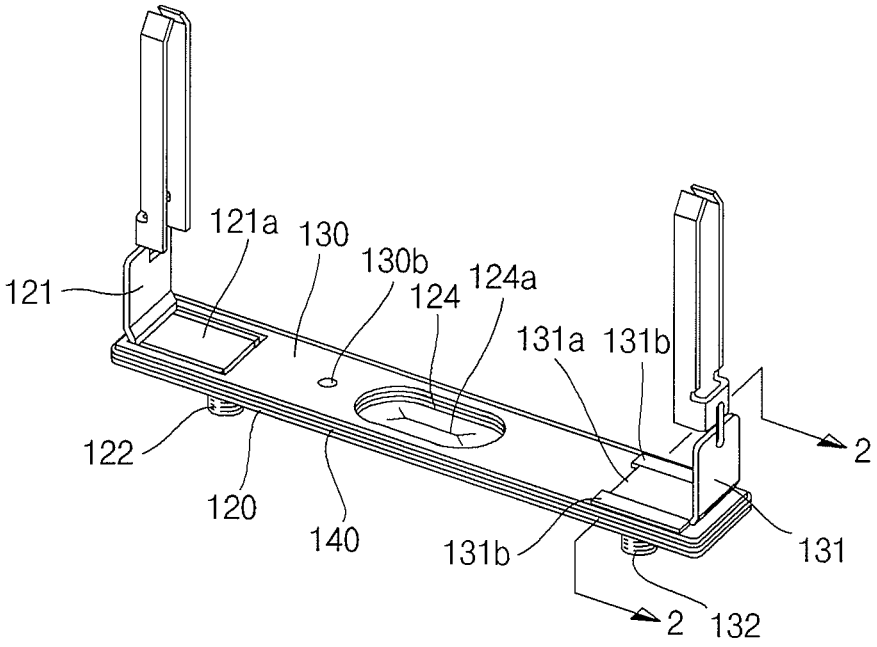

121
121a
130
130b
124
124a
131a
131b
122
120
140
131b
131
2
2
132

FIG. 4B

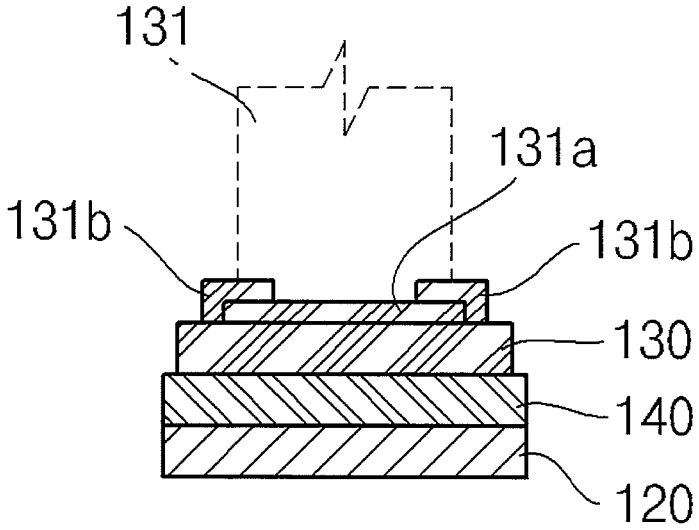
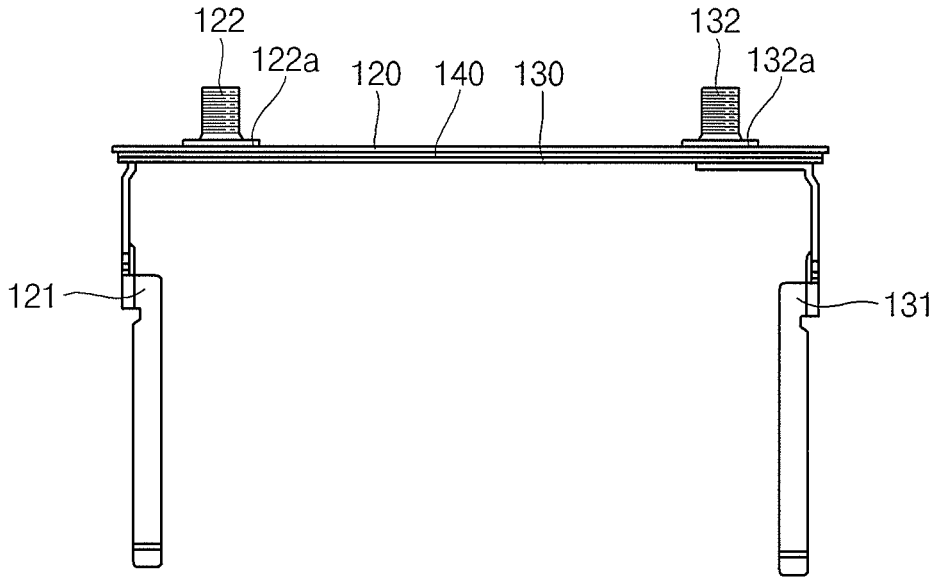

131
131a
131b
131b
130
140
120

FIG. 5



SECONDARY BATTERY

CROSS-REFERENCE TO RELATED APPLICATION

This application claims priority to and the benefit of Korean Patent Application No. 10-2010-0130956 filed in the Korean Intellectual Property Office on Dec. 20, 2010, the entire content of which is incorporated herein by reference.

BACKGROUND

1. Field

Embodiments of the present invention relate to a secondary battery.

2. Description of Related Art

Secondary batteries are rechargeable, unlike primary batteries. Among such secondary batteries, a low capacity battery including a battery cell in the form of a pack may be used for small portable electronic devices such as cellular phones and camcorders, and a high capacity battery including a plurality (e.g., dozens) of battery cells connected to one another may be used as a motor-driving power source for electric scooters, hybrid vehicles, or electric vehicles.

Secondary batteries are manufactured in various shapes such as cylindrical shapes and prismatic shapes. A secondary battery may be constructed as follows: an electrode assembly is formed by placing an insulating separator between a positive electrode plate and a negative electrode plate; the electrode assembly is placed in a case together with electrolyte, and a cap plate is placed on the case. The electrode assembly is connected to positive and negative terminals which protrude from the cap plate and are exposed to the exterior of the electrode assembly.

SUMMARY

An aspect of the present invention provides a secondary battery in which an electrode terminal and a plate are combined as one part to simplify manufacturing processes and reduce costs.

According to an embodiment, a secondary battery includes: an electrode assembly comprising a first electrode plate, a separator, and a second electrode plate; a first collecting plate electrically coupled to the first electrode plate; a second collecting plate electrically coupled to the second electrode plate; a case containing the electrode assembly, the first collecting plate, and the second collecting plate; a first electrode terminal electrically coupled to the first collecting plate; a second electrode terminal electrically coupled to the second collecting plate; a first plate coupled to the first collecting plate and the first electrode plate and configured to seal the case; a second plate coupled to the second collecting plate and the second electrode terminal; and an insulation plate between the first plate and the second plate.

The insulation plate may include a material selected from the group consisting of polyphenylene sulfide (PPS), polyethylene (PE), polypropylene (PP), polybutylene terephthalate (PBT), polyamide (PA), and combinations thereof.

The first electrode terminal may be welded to the first plate at a location near a first end of the first plate, and a first hole may be formed at a location near a second end of the first plate opposite the first end.

The second electrode terminal may be inserted in the first hole.

The first plate may include aluminum.

The second electrode terminal may be welded to the second plate at a location near a first end of the second plate, and a second hole may be formed at a location near a second end of the second plate opposite the first end.

The first collecting plate may be inserted in the second hole.

The second electrode terminal may be inserted in a first hole formed in the first plate at a location near an end of the first plate and a first hole formed in the insulation plate at a location near an end of the insulation plate.

A protrusion may be formed around the first hole of the insulation plate, and the protrusion may be inserted through the first hole of the first plate.

The first collecting plate may be inserted through a second hole formed in the insulation plate at a location near an end of the insulation plate and a second hole formed in the second plate.

The second plate may include copper.

The first collecting plate and the first plate may be welded together.

The second collecting plate and the second plate may be welded together.

The secondary battery may further include a safety vent in the first plate between the first electrode and a first hole of the first plate; a third hole in the second plate between the second electrode terminal and a second hole of the second plate; and a third hole in the insulation plate between first and second holes of the insulation plate, wherein the safety vent, the third hole of the second plate, and the third hole of the insulation plate have corresponding sizes.

The secondary battery may further include: an electrolyte injection hole in the first plate between the safety vent and the first electrode terminal of the first plate; a fourth hole in the second plate between the second and third holes of the second plate; and a fourth hole in the insulation plate between the second and third holes of the insulation plate, wherein the electrolyte injection hole, the fourth hole of the second plate, and the fourth hole of the insulation plate have corresponding sizes.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings are included to provide a further understanding of embodiments of the present invention, and are incorporated in and constitute a part of this application. The drawings illustrate exemplary embodiments of the present invention and, together with the description, serve to explain principles of embodiments of the present invention. In the drawings:

FIG. **1** is a perspective view illustrating a secondary battery according to an embodiment;

FIG. **2** is a cross-sectional view of the secondary battery of FIG. **1** taken along the line I-I' of FIG. **1**;

FIG. **3** is an exploded perspective view illustrating a first plate, a second plate, and an insulation plate of the secondary battery illustrated in FIG. **1**;

FIG. **4**A is a perspective view illustrating an assembled state of the first plate, the second plate, and the insulation plate illustrated in FIG. **3**;

FIG. **4**B is a sectional view taken along the line **2**-**2** of FIG. **4**A to illustrate an assembled state of the second plate and a second collecting plate; and

FIG. **5** is a front view illustrating the assembled state of the first plate, the second plate, and the insulation plate of FIG. **3**.

DETAILED DESCRIPTION OF THE EMBODIMENTS

Example embodiments will now be described more fully hereinafter with reference to the accompanying drawings;

however, they may be embodied in different forms and should not be construed as limited to the embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the disclosure to those skilled in the art.

Hereinafter, a secondary battery will be described with reference to the accompanying drawings according to exemplary embodiments.

First, a secondary battery will be described according to an embodiment. FIG. **1** is a perspective view illustrating a secondary battery **100** according to an embodiment. FIG. **2** is a cross-sectional view of the secondary battery **100** of FIG. **1** taken along the line I-I' of FIG. **1**. FIG. **3** is an exploded perspective view illustrating a first plate, a second plate, and an insulation plate of the secondary battery illustrated in FIG. **1**. FIG. **4**A is a perspective view illustrating an assembled state of the first plate, the second plate, and the insulation plate illustrated in FIG. **3**. FIG. **4**B is a sectional view taken along the line **2-2** of FIG. **4**A to illustrate an assembled state of the second plate and a second collecting plate. FIG. **5** is a front view illustrating the assembled state of the first plate, the second plate, and the insulation plate of FIG. **3**.

As shown in FIG. **1** and FIG. **2**, the secondary battery **100** of one embodiment includes an electrode assembly **110**, a first plate **120**, a second plate **130**, an insulation plate **140**, and a case **150**.

The electrode assembly **110** is formed by winding or stacking a first electrode plate **111**, a separator **113**, and a second electrode plate **112**, each of which having a thin plate or film shape. The first electrode plate **111** may function as a negative electrode, and the second electrode plate **112** may function as a positive electrode. In other embodiments, the first electrode plate **111** and the second electrode plate **112** may have opposite polarities (e.g., the first electrode plate **111** may function as a positive electrode and the electrode plate **112** may function as a negative electrode).

The first electrode plate **111** is formed by applying a first electrode active material such as graphite or carbon to a first electrode collector formed of metal foil such as nickel or copper foil. The first electrode plate **111** includes a first electrode non-coating portion **111***a* to which the first electrode active metal is not applied. The first electrode non-coating portion **111***a* functions as a current flow passage between the first electrode plate **111** and the outside of the first electrode plate **111**. In the described embodiment, materials that can be used to form the first electrode plate **111** are not limited to the above-mentioned materials.

The second electrode plate **112** is formed by applying a second electrode active material such as a transition metal oxide to a second electrode collector formed of metal foil such as aluminum foil. The second electrode plate **112** includes a second electrode non-coating portion **112***a* to which the second electrode active metal is not applied. The second electrode non-coating portion **112***a* functions as a current flow passage between the second electrode plate **112** and the outside of the second electrode plate **112**. In the described embodiment, materials that can be used to form the second electrode plate **112** are not limited to the above-mentioned materials.

The polarities of the first and second electrode plates **111** and **112** may be changed with each other.

The separator **113** may be interposed between the first electrode plate **111** and the second electrode plate **112** to prevent a short circuit and allow movement of ions such as lithium ions. The separator **113** may be formed of a polyethylene film, a polypropylene film, or a film including polyethylene and polypropylene. In the described embodiment, materials that can be used to form the separator **113** are not limited to the above-mentioned materials.

The first and second plates **120** and **130** are coupled to the end parts of the electrode assembly **110** in a manner such that the first and second plates **120** and **130** are electrically coupled (or electrically connected) to the first and second electrode plates **111** and **112**, respectively.

The electrode assembly **110** is accommodated in the case **150** together with electrolyte. The electrolyte may include an organic solvent such as ethylene carbonate (EC), propylene carbonate (PC), diethyl carbonate (DEC), ethyl methyl carbonate (EMC), and dimethyl carbonate (DMC); and a lithium salt such as $LiPF_6$ or $LiBF_4$. The electrolyte may be liquid, solid, or gel.

As shown in FIGS. **2** and **3**, the first plate **120** includes a first collecting plate **121**, a first electrode terminal **122**, a plug **123**, and a safety vent **124**.

The first plate **120** seals the case **150** (described later). The first plate **120** may be formed of aluminum or an aluminum alloy. The first electrode terminal **122** may be welded near one end (e.g., a first end) of the first plate **120**, and a first hole **120***a* may be formed through the first plate **120** near an end (e.g., a second end) opposite to the end near which the first electrode terminal **122** is welded. A second electrode terminal **132** is inserted in the first hole **120***a*. Thus, the first hole **120***a* is sized such that the second electrode terminal **132** can be inserted in the first hole **120***a*.

The first plate **120** includes the safety vent **124** between the first hole **120***a* and the first electrode terminal **122**. An electrolyte injection hole **120***c* is formed between the first electrode terminal **122** and the safety vent **124** of the first plate **120**.

The first collecting plate **121** makes contact with a first electrode non-coating portion **111***a* protruding from an end of the electrode assembly **110**. The first collecting plate **121** is welded to the first electrode non-coating portion **111***a*. The first collecting plate **121** has an approximately L-shape (or an approximately reverse L-shape). Similar to the first electrode terminal **122**, the first collecting plate **121** may be formed of aluminum or an aluminum alloy. In one embodiment, the first collecting plate **121** is welded to the first plate **120**.

As shown in FIG. **3**, the first collecting plate **121** is inserted through a second hole **140***b* formed at an end (or near an end) of the insulation plate **140** and a second hole **130***a* formed in the second plate **130**.

The first collecting plate **121** includes a first bent part **121***a* (see FIG. **2**). The first bent part **121***a* is bent from the first collecting plate **121** approximately at a right angle and is welded to the bottom side of the first plate **120** as a part of the first plate **120**.

The first electrode terminal **122** is electrically coupled (or electrically connected) to the first electrode plate **111** shown in FIG. **2**. The first electrode terminal **122** may be formed of the same material as that used to form the first plate **120**. For example, the first electrode terminal **122** may be formed of aluminum. The first electrode terminal **122** includes a first connection part **122***a* at a lower end. The connection part **122***a* is wider than the first electrode terminal **122**. The first connection part **122***a* may have an approximately hexahedron shape. The first connection part **122***a* is welded to the first plate **120** as a part of the first plate **120**.

The plug **123** seals the electrolyte injection hole **120***c* of the first plate **120**.

The safety vent **124** is located (or arranged) on a vent hole **120***b* of the first plate **120**, and a notch **124***a* is formed in the safety vent **124** so that the safety vent **124** can be opened (e.g., opened at a preset pressure).

The second plate **130** includes a second collecting plate **131** and the second electrode terminal **132**.

The second plate **130** is located under the first plate **120**. The second plate **130** may be formed of copper or a copper alloy. The second plate **130** and the second collecting plate **131** are welded together. The second electrode terminal **132** may be welded near one end (e.g., a first end) of the second plate **130**, and the second hole **130***a* may be formed through the second plate **130** near an end (e.g., a second end) opposite to the end near which the second electrode terminal **132** is welded. The second hole **130***a* has a size such that the first collecting plate **121** can be inserted in the second hole **130***a*.

A fourth hole **130***c* (which may be referred to as a third hole) may be formed at a center part between the second electrode terminal **132** and the second hole **130***a* of the second plate **130**. A third hole **130***b* (which may be referred to as a fourth hole) may be formed between the second hole **130***a* and the fourth hole **130***c* of the second plate **130**. The third hole **130***b* has a size corresponding to the size of the electrolyte injection hole **120***c* of the first plate **120**. The fourth hole **130***c* has a size corresponding to the size of the safety vent **124** of the first plate **120**.

The second collecting plate **131** makes contact with the second electrode non-coating portion **112***a* protruding from an end of the electrode assembly **110**. The second collecting plate **131** is welded to the second electrode non-coating portion **112***a*. The second collecting plate **131** has an approximately L-shape (e.g., an approximately reverse L-shape). The second collecting plate **131** is welded to the second plate **130**.

As shown in FIGS. **4**A and **4**B, the second collecting plate **131** includes a second bent part **131***a* and second lateral parts **131***b*.

The second bent part **131***a* is bent from the second collecting plate **131** approximately at a right angle and is welded to the bottom side of the second plate **130** as a part of the second plate **130**. The second lateral parts **131***b* are disposed at sides (e.g., edges) of the second bent part **131***a* and are spaced apart from each other by a distance corresponding to the width (or length) of the second bent part **131***a*. After the second bent part **131***a* is coupled to the second lateral parts **131***b* by sliding the second bent part **131***a* into the second lateral parts **131***b*, the second bent part **131***a* is fixed to the second collecting plate **131** by welding. The first collecting plate **121** and the first plate **120** may be coupled to each other in substantially the same way.

The second electrode terminal **132** is electrically coupled (or electrically connected) to the second electrode plate **112** (see FIG. **2**). Like the second plate **130**, the second electrode terminal **132** may be formed of copper or a copper alloy. The second electrode terminal **132** may have the same or a similar shape as that of the first electrode terminal **122**. Thus, the shape of the second electrode terminal **132** will not be described.

Referring to FIG. **3**, the second electrode terminal **132** is inserted through the first hole **120***a* formed in an end (or near an end) of the first plate **120** and a first hole **140***a* formed in an end (or near an end) of the insulation plate **140**.

A second connection part **132***a* is disposed between the second electrode terminal **132** and the second plate **130**. The second connection part **132***a* has a height or size corresponding to the thicknesses of the first plate **120** and the insulation plate **140**.

The width of the second plate **130** may be smaller than that of the first plate **120**. The first plate **120** is electrically coupled to the case **150** by welding, and the second plate **130** is not electrically connected to the case **150** in order to prevent a short circuit.

The insulation plate **140** is disposed between the first and second plates **120** and **130** to electrically insulate the first and second plates from each other. The insulation plate **140** may be formed of an insulating material which has high heat resistance, strength, and electrical insulating properties and does not react with an electrolyte. For example, the insulation plate **140** may be formed of a material selected from polyamide, polyphenylene sulfide resin, and polypropylene. However, materials that can be used to form the insulation plate **140** are not limited thereto.

The first hole **140***a* and the second hole **140***b* are formed in both ends (e.g., opposite ends) of the insulation plate **140**. The first collecting plate **121** is inserted in the second hole **140***b*, and the second hole **140***b* has substantially the same size as that of the second hole **130***a* of the second plate **130**. The second electrode terminal **132** is inserted in the first hole **140***a*, and the first hole **140***a* has substantially the same size as that of the first hole **120***a* of the first plate **120**. A protrusion **140***e* having a height corresponding to the thickness of the first plate **120** is formed at the first hole **140***a* (e.g., along the circumference of the first hole **140***a*). The protrusion **140***e* is inserted through the first hole **120***a* of the first plate **120**. Therefore, the protrusion **140***e* insulates the first plate **120** and the second electrode terminal **132** from each other.

A fourth hole **140***d* (which may be referred to as a third hole) may be formed in a center part between the first and second holes **140***a* and **140***b* of the insulation plate **140**. A third hole **140***c* (which may be referred to as a fourth hole) may be formed between the second and fourth holes **140***b* and **140***d* of the insulation plate **140**. The third hole **140***c* has a size corresponding to the size of the electrolyte injection hole **120***c* of the first plate **120**. The fourth hole **140***d* has a size corresponding to the size of the safety vent **124** of the first plate **120**.

That is, when the first plate **120**, the second plate **130**, and the insulation plate **140** are assembled as shown in FIG. **5**, the safety vent **124** of the first plate **120**, the fourth hole **130***c* of the second plate **130**, and the fourth hole **140***d* of the insulation plate **140** are aligned with each other and have substantially the same size. In addition, the electrolyte injection hole **120***c* of the first plate **120**, the third hole **130***b* of the second plate **130**, and the third hole **140***c* of the insulation plate **140** are aligned with each other and have substantially the same size.

The case **150** may be formed of a conductive metal such as aluminum, aluminum alloy, or steel plated with nickel. The case **150** may have an approximately hexahedral shape with an opening so that the electrode assembly **110**, the first collecting plate **121**, and the second collecting plate **131** can be inserted and placed in the case **150**. The inner surface of the case **150** may be treated so that the case **150** can be electrically insulated from the electrode assembly **110**, the first collecting plate **121**, and the second collecting plate **131**.

According to embodiments of the present invention, since the electrode terminals and the plates of the secondary battery are combined as one part, manufacturing processes can be simple, and costs can be reduced.

In addition, since the electrode terminals and the plates of the secondary battery are combined as one part, leakage of electrolyte can be reduced or prevented.

Exemplary embodiments have been disclosed herein, and although specific terms are employed, they are used and are to be interpreted in a generic and descriptive sense only and not for purpose of limitation. Accordingly, it will be understood by those of ordinary skill in the art that various changes in form and details may be made without departing from the

spirit and scope of the present disclosure as set forth in the following claims and their equivalents.

What is claimed is:

1. A secondary battery comprising:

an electrode assembly comprising a first electrode plate, a separator, and a second electrode plate;

a first collecting plate electrically coupled to the first electrode plate;

a second collecting plate electrically coupled to the second electrode plate;

a case having an opening for receiving the electrode assembly, the first collecting plate, and the second collecting plate;

a first electrode terminal electrically coupled to the first collecting plate;

a second electrode terminal electrically coupled to the second collecting plate;

a first plate electrically coupled to the first collecting plate and the first electrode plate and configured to seal the case by covering substantially entire said opening of the case;

a second plate coupled to the second collecting plate and the second electrode terminal; and

an insulation plate between the first plate and the second plate,

wherein the second electrode terminal is welded to the second plate at a location near a first end of the second plate, and a collecting plate hole is formed at a location near a second end of the second plate opposite the first end, and

wherein the first collecting plate is inserted in the collecting plate hole.

2. The secondary battery as claimed in claim **1**, wherein the insulation plate comprises a material selected from the group consisting of polyphenylene sulfide (PPS), polyethylene (PE), polypropylene (PP), polybutylene terephthalate (PBT), polyamide (PA), and combinations thereof.

3. The secondary battery as claimed in claim **1**, wherein the first electrode terminal is welded to the first plate at a location near a first end of the first plate, and a first hole is formed at a location near a second end of the first plate opposite the first end.

4. The secondary battery as claimed in claim **3**, wherein the second electrode terminal is inserted in the first hole.

5. The secondary battery as claimed in claim **1**, wherein the first plate comprises aluminum.

6. The secondary battery as claimed in claim **1**, wherein the second electrode terminal is inserted in a first hole formed in the first plate at a location near an end of the first plate and a first hole formed in the insulation plate at a location near an end of the insulation plate.

7. The secondary battery as claimed in claim **6**, wherein a protrusion is formed around the first hole of the insulation plate, and the protrusion is inserted through the first hole of the first plate.

8. The secondary battery as claimed in claim **1**, wherein the first collecting plate is inserted through a collecting plate hole formed in the insulation plate at a location near an end of the insulation plate and the collecting plate hole formed in the second plate.

9. The secondary battery as claimed in claim **1**, wherein the second plate comprises copper.

10. The secondary battery as claimed in claim **1**, wherein the first collecting plate and the first plate are welded together.

11. The secondary battery as claimed in claim **1**, wherein the second collecting plate and the second plate are welded together.

12. The secondary battery as claimed in claim **1**, further comprising:

a safety vent in the first plate between the first electrode terminal and a first hole of the first plate;

an alignment hole in the second plate between the second electrode terminal and the collecting plate hole of the second plate; and

a third hole in the insulation plate between first and second holes of the insulation plate,

wherein the safety vent, the alignment hole of the second plate, and the third hole of the insulation plate have corresponding sizes.

13. The secondary battery as claimed in claim **12**, further comprising:

an electrolyte injection hole in the first plate between the safety vent and the first electrode terminal of the first plate;

between hole in the second plate between the collecting plate hole and the alignment hole of the second plate; and

a fourth hole in the insulation plate between the second and third holes of the insulation plate,

wherein the electrolyte injection hole, the between hole of the second plate, and the fourth hole of the insulation plate have corresponding sizes.

14. A secondary battery comprising:

an electrode assembly comprising a first electrode plate, a separator, and a second electrode plate;

a first collecting plate electrically coupled to the first electrode plate;

a second collecting plate electrically coupled to the second electrode plate;

a case containing the electrode assembly, the first collecting plate, and the second collecting plate;

a first electrode terminal electrically coupled to the first collecting plate;

a second electrode terminal electrically coupled to the second collecting plate;

a first plate coupled to the first collecting plate and the first electrode plate and configured to seal the case;

a second plate coupled to the second collecting plate and the second electrode terminal; and

an insulation plate between the first plate and the second plate,

wherein the second electrode terminal is welded to the second plate at a location near a first end of the second plate, and a second hole is formed at a location near a second end of the second plate opposite the first end, and the first collecting plate is inserted in the second hole.

15. A secondary battery comprising:

an electrode assembly comprising a first electrode plate, a separator, and a second electrode plate;

a first collecting plate electrically coupled to the first electrode plate;

a second collecting plate electrically coupled to the second electrode plate;

a case containing the electrode assembly, the first collecting plate, and the second collecting plate;

a first electrode terminal electrically coupled to the first collecting plate;

a second electrode terminal electrically coupled to the second collecting plate;

a first plate coupled to the first collecting plate and the first electrode plate and configured to seal the case;

a second plate coupled to the second collecting plate and the second electrode terminal;

an insulation plate between the first plate and the second plate;

a safety vent in the first plate between the first electrode terminal and a first hole of the first plate;

a third hole in the second plate between the second electrode terminal and a second hole of the second plate; and

a third hole in the insulation plate between first and second holes of the insulation plate,

wherein the safety vent, the third hole of the second plate, and the third hole of the insulation plate have corresponding sizes.

16. The secondary battery as claimed in claim **15**, further comprising:

an electrolyte injection hole in the first plate between the safety vent and the first electrode terminal of the first plate;

a fourth hole in the second plate between the second and third holes of the second plate; and

a fourth hole in the insulation plate between the second and third holes of the insulation plate,

wherein the electrolyte injection hole, the fourth hole of the second plate, and the fourth hole of the insulation plate have corresponding sizes.

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